

Abstract

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Descent with Modification: Thermal Reactions of Subsurface H₂O₂ of Relevance to Icy Satellites and Other Small Bodies

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Laboratory experiments have demonstrated that magnetospheric radiation in the Jovian system drives reaction chemistry in ices at temperatures relevant to Europa and other icy satellites. Similarly, cosmic radiation (mainly protons) acting on cometary and interstellar ices can promote extensive chemical change. Among the products that have been identified in irradiated H₂O-ice is hydrogen peroxide (H₂O₂), which has been observed on Europa and is suspected on other worlds. Although the infrared spectra and radiation chemistry of H₂O₂-containing ices are well documented, the thermally-induced solid-phase chemistry of H₂O₂ is largely unknown. Therefore, in this presentation we report new laboratory results on reactions at 50 - 130 K in ices containing H₂O₂ and other molecules, both in the presence and absence of H₂O. As an example of our results, we find that warming H₂O + H₂O₂ + SO₂ ices promotes SO₂ oxidation to SO₄²⁻. We suspect that such redox chemistry may explain some of the observations related to the presence and distribution of H₂O₂ across Europa's surface as well as the lack of H₂O₂ on Ganymede and Callisto. If other molecules prove to be just as reactive with frozen H₂O₂ then it may explain why H₂O₂ has been absent from surfaces of many of the small icy bodies that are known to be exposed to ionizing radiation. Our results also have implications for the survival of H₂O₂ as it descends towards a subsurface ocean on Europa.

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